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DATE March 1/91
AUTHORIZED BY

MINERALOGICAL STUDY OF SILICA SAND FROM MOUNTAIN MINERALS COMPANY, ALBERTA

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January 1985

Project MRP - 3.3.9.9.99
Cost Recovery - START
Job Number 025196

MINERALS RESEARCH PROGRAM
MINERAL SCIENCES LABORATORIES
DIVISION REPORT MRP/MSL 85-4(CR) **CONFIDENTIAL**

6pp

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91-04930/

MINERALOGICAL STUDY OF SILICA SAND FROM MOUNTAIN MINERALS COMPANY, ALBERTA

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SUMMARY OF RESULTS

The mineralogy of high purity quartz sand containing 99.74 wt % SiO_2, 0.065 wt % Fe_2O_3 and 0.085 wt % Al_2O_3 was studied to determine the characteristics of the impurities. It was found that the sample contains trace amounts of calcite, dolomite, ankerite, clay minerals, zircon, iron-alumino-silicates, sericite, biotite, hematite, goethite and pyrite. The iron in the sample is due to minute inclusions of hematite and rarely pyrite in quartz and calcite to separate grains of goethite, ankerite and iron-alumino-silicates and to a film of iron oxide on quartz particles. The Al_2O_3 is due to a coating of clay minerals on quartz and to separate iron-alumino-silicate grains.

INTRODUCTION

A sample of washed and de-slimed silica sand which had been obtained from Mountain Minerals Company, Alberta was received from P. Andrews of the Mineral Processing Laboratory on October 10, 1984. Mr. Andrews reported that the sample was from Golden, B.C. and contained approximately 99.74 wt % SiO_2, 0.065 wt % Fe_2O_3 and 0.085 wt % Al_2O_3. He requested that the minerals contaminating the silica be identified and their liberation size determined in order to establish whether the iron can be removed from the silica. Work on this sample is performed under Project 3.3.9.9.99 as START Project Job No. 025196. The sample received consisted of about 50 grams of 28-200 µm material.

METHOD OF INVESTIGATION

The sample was split and one-half was separated into sink and float fractions with a heavy liquid having a specific gravity of 2.96. The float fraction was further separated into magnetic and non-magnetic fractions with a Frantz isodynamic separator. Polished sections were prepared from the resulting fractions as well as from the split of the original sample. The polished sections were studied with an optical microscope and with the SEM-based image analysis system.

RESULTS

The quantity of material in each fraction is reported in Table 1.

Table 1 - Weight per cent of material in fractions

Fraction		Wt %
Non-mag	2.96 float	99.74
Mag	2.96 float	0.23
	2.96 sink	0.03
Total		100.00

The minerals observed in the polished sections were identified using the optical microscope and the scanning elecron microscope equipped with the energy dispersive X-ray analyser (EDXA). The sample consists of quartz and contains trace amounts of calcite, dolomite, ankerite, clay minerals (probably kaolinite), ziron, iron-poor and iron-rich alumino-silicates (probably pyroxene), sericite, biotite, hematite, goethite and pyrite. Mineral quantities in the 2.96 sink and magnetic 2.96 float fractions were determined with the image analyser. The results are given in Table 2. The quartz and calcite grains in the 2.96 float magnetics fraction contain minute inclusions of hematite.

Table 2 - Mineral quantities in fractions

Mineral	2.96 sink vol %	Mag. 2.96 float vol %
quartz + trace clay mineral	14.7	88.0
calcite	-	8.9
dolomite + ankerite + mica	-	2.6
hematite*	-	0.5
goethite	4.0	-
low-Fe alumino silicate	18.9	-
high-Fe alumino silicate	10.6	-
zircon	51.8	-
Total	100.0	100.0

* minute (<5 m) inclusions in quartz and calcite.

Mineral quantities were not determined for the non-mag. 2.96 float fraction and for the original sample because in the SEM backscatter and secondary electron modes the quartz grains exhibit a white halo (Fig. 1). Such a white halo would normally suggest that the quartz is surrounded by a mineral that has a high atomic number, but only Si was detected by EDXA. In some places, however, minute grains of lead, derived from the polishing lap, are

packed into the quartz-araldite interface. EDXA analyses of this lead invariably show a weak peak for iron and occasionally for aluminum. This suggests that the quartz was coated with a thin film of iron oxide and occasionally clay minerals. Such a film would interfere with adhesion of the quartz to araldite, and would give rise to the appearance of a halo around the quartz particles. It is interpreted that wherever the film was thick, it was partly plucked and the hole was filled with lead from the lap but enough of the film remained to be detected by EDXA. This suggests that the film was composed of an iron oxide and clay.

The zircon and most of the calcite and alumino silicates in the fractions are present as free grains. Some of the calcite and alumino silicates, however, are intergrown with dolomite and ankerite. The latter two minerals occur only as intergrowths.

The quartz is present as free grains but some grains contain small inclusions of calcite, mica, dolomite, clay minerals, hematite and pyrite. The hematite and pyrite are generally present as very small grains, and most are completely enclosed in the quartz.

The iron is present as (1) minute inclusions of hematite and rarely pyrite in quartz and calcite; (2) as separate goethite grains; (3) as separate iron-alumino-silicate grains; (4) as ankerite and (5) possibly as a film of iron oxide on the quartz particles. The ankerite is present as intergrowths with dolomite, calcite and quartz. The presence of an iron oxide film is interpreted on the basis of detecting iron at a few points on the edges of the grains. The proportion of iron occurring as each type was not determined.

CONCLUSION

The mineralogical study indicates that it should be possible to remove some of the iron from the quartz, but not by a single process. It is suggested that most of the iron that occurs as separate iron-bearing minerals and as hematite inclusions in quartz can be removed with a high intensity magnetic separator. It is further suggested that the iron in ankerite and the film of iron oxide can be removed by leaching in acid solution.

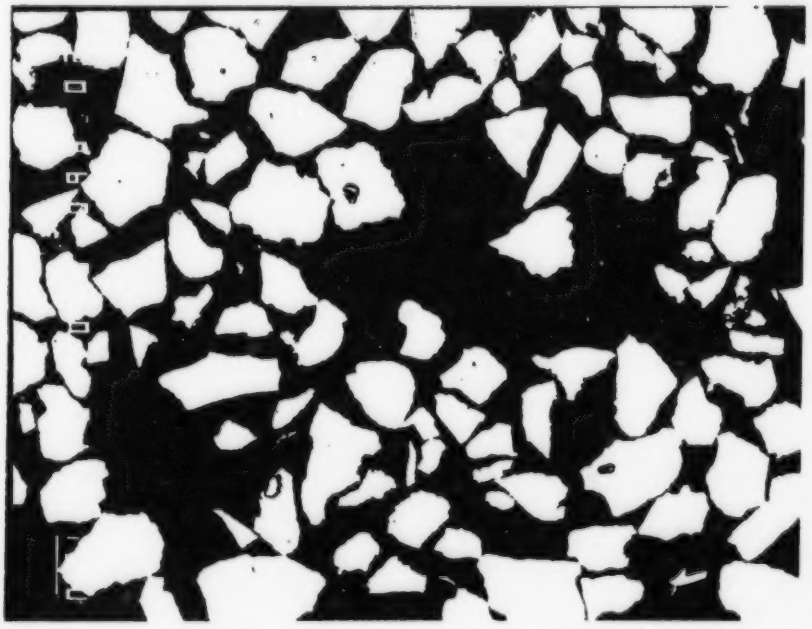

Fig. 1 - SEM-BSE photograph of original sample. Note the white halos around the quartz particles and two grains of calcite (white).